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Quantum memory based on phase matching control

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Abstract

We discuss a class of quantum memory (QM) scheme based on phase matching control (PMC). A single-photon wave packet can be mapped into and retrieved on demand from a long-lived spin grating in the presence of a control field, forming along with the signal field a Raman configuration, when the wave vector of the control field is continuously changed in time. Such mapping and retrieval takes place due to the phase matching condition and requires neither a variation of the amplitude of the control field nor inhomogeneous broadening of the medium. We discuss the general model of PMC QM and its specific implementation via (i) modulation of the refractive index, (ii) angular scanning of the control field, and (iii) its frequency chirp. We show that the performance of the PMC QM protocol may be as good as those realized in the gradient echo memory (GEM) but achieved with less stringent requirements on the medium. We suggest the experimental realization of PMC QM in nitrogen vacancies (NV) and silicon vacancies (SiV) in diamond as well as in rare-earth doped crystals. © 2014 Astro Ltd.

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Keywords

Gradient echo memory, Phase matching control, Quantum memory